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ABSTRACT

A study was conducted to determine a relevant curriculum for the electronic engineering technology programs of junior colleges in Taiwan that would meet workplace demand. Using a revised DACUM (Developing a Curriculum) technique, a duty-task profile of electronic technicians, which contained 12 duties and 73 tasks, was first constructed. Based on the profile, a list of professional subjects for the two-year junior colleges' electronic engineering program, composed of 26 subjects, was developed by a curriculum development team of electronic engineering technology program faculty. The list was sent to 29 two-year junior colleges that had electronic engineering programs. Four electronic engineering program faculty in each of those 29 colleges were requested to determine whether each subject listed should be either required or optional, or both, and the appropriateness of both credit- and time-allocation of each subject. The result of the study was a relevant curriculum that should help students in two-year electronic engineering programs of junior colleges meet employers' demands. (Contains 15 references.) (Author/KC)

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Using Revised DACUM and Survey to Determine Electronic Engineering Technology Curriculum

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ABSTRACT

Current curricula of two-year electronic engineering program of junior colleges in Taiwan have been increasingly expected to reflect workplace demand. To help achieve this expectation, the purpose of this study was to determine a relevant curriculum for the electronic engineering technology programs. Having adopted a revised DACUM technique, a duty-task profile of electronic technicians, which contained 12 duties and 73 tasks, was first constructed. Then, based on the profile, a list of professional subjects for the twe-year junior colleges' electronic engineering program, composed of 26 subjects, was developed by a curriculum development team comprising electronic engineering technology program faculty. After that, the list was tranformed to 29 two-year junior colleges in which had electronic engineering programs. Four electronic engineering pragram faculty in each of those 29 colleges were requested to determine: (1) each subject listed should be either required or optional, or both and (2) the appropriateness of both credit- and time-allocation of each subject. The result of this study presented a relevent curriculum which should help the students in two-year electronic engineering program of junior colleges meet thier employers' demand.

keywords : DACUM, Electronic Engineering, Technology Curriculum.

I. Introduction

Junior college of technology is an important part of the technological and vocational education system in Taiwan,R.O.C.. It is the stepping stone from vocational schools to colleges of technology. Junior college of technology aims at cultivating professionals and thus becomes the main source of the middle level professionals of the job market (Lin, 1992). Following the domestic economic development, technological advance and social changes, the future demand of the job market for the quality of the manpower level of junior college of technology will be enhanced, in order to maintain the industrial development. When the society is becoming more and more highly modernized and informationalized, Junior colleges of technology should pay attention to the upgrade of the education standard, and there is no time to waste (Chang, 1994).

Though there is not any uniformed outline to define the concept and definition of curricular, the major concept lies on the following points: (1) the objectives and goals of curricular; (2) curricular include subjects and teaching materials; (3) curricular refer to an organized learning activity and experience; and (4) curricular are (emphasize on) results of learning. The characteristics of professional school include (1) job orientation; (2) content of curricular should include a wide variety of knowledge, skills, attitude and sense of value; (3) the important indicator of curricular effectiveness includes student practical and application abilities at school and student actual performance in work; (4) the basic requirement of curricular should maintain a close connection with the occupational requirement; (5) curricular needs active participation from government and should follow the national policy and demand; (6) curricular should satisfy personal demands and social, economic and technological changes; and (7) a successful implementation of curricular requires the support of related personnel, machinery and equipment and teaching sources (Kang & Hsiao, 1994).

The inferior quality of electronic, computer and telecommunication professionals is closely related to teaching, the possible causes include (1) technology advances day by day, but the progress of teaching content is slow; (2) curricular content over emphasizes on theory and lacks practical training; (3) school curricular contains low integrating ability and lacks complete local teaching materials (Chen, 1994). In addition, when electronic major students go to work, they generally feels difficult to fit in technological work; though smarter students know the theory, it is difficult for them to engage in practical design; and for weaker students, they neither know the theory nor the practical; some students even have to go through the short-term special training provided by private enterprises or the long-term training provided by vocational training centers before they can get a job (Chang & Chen, 1994). The situation is getting worse since the implementation of the new curricular in junior colleges in academic year 1995 where syllabus and equipment standards are replaced by the subjects table and teaching material outlines (Chang, 1994). Therefore, to combine the power of the market and professional school to develop an effective technological curricular so as to make electronic major students of junior colleges to be equipped with sufficient ability to satisfy the demand of the market is urgent and important.

Based on the aforementioned background and motivation, the present research aims at (1) confirming the required technical subjects and their credits and credit-hours of electronic major students of two-year junior colleges; (2) investigating the opinions of chairpersons and teachers of electronic faculty toward the said subjects, credits and credit-hours; and (3) proposing the result of the study to be reference for the implementation of the new curricular for electronic faculty of junior colleges.

II. Analysis of Technological Competency of Job

To find out the required subjects for electronic major students of two-year junior colleges, we have first performed the analysis of technological ability of job on graduates of deparment of electronic engineering of junior college. The revised DACUM and V-TECS methods have been adopted together with the questionnaire survey and in-the-field interview from the viewpoint of employer to draw out the job technological competencies and job content with which electronic major graduate should be equipped. There are 12 duties and 73 tasks.

DUTY TASK

DUTYA: select electronic components

TASK1: select basic passive parts.
TASK2: select basic active parts.
TASK3: select analog IC parts.
TASK4: digital IC parts.
TASK5: select ADC/DAC parts.
TASK6: select sensor/transducer parts.
TASK7: select peripheral parts.
TASK8: select connection parts.
TASK9: select consumable material.

DUTYB: use electronic instruments

TASK1: operate R.L.C.meter.
TASK2: operate DVM.
TASK3: operate function.
TASK4: operate counter.
TASK5: operate IC tester.
TASK6: operate digital/analog scope.

DUTYC: construct analog circuits

TASK1: combine DC low-voltage circuits.
TASK2: combine low-frequency amplifier circuits.
TASK3: combine high-frequency amplifier circuits.
TASK4: combine power amplifier circuits.
TASK5: combine low-frequency oscillation circuits.
TASK6: combine high-frequency oscillation circuits.
TASK7: combine filter circuits.
TASK8: combine wave-shaping circuits.
TASK9: combine driver circuits.

DUTYD: construct digital circuits

TASK1: combine combinational logic circuits. TASK combine sequential logic circuits.
TASK3: combine counter/timer circuits.
TASK4: combine display/driver circuits.
TASK5: construct logic control circuits.
TASK6: construct EPLD/FPGK firmware.

DUTYE: construct microprocessor system circuits

TASK1: select microprocessor parts.
TASK2: select memory IC parts.
TASK3: interface IC parts.
TASK4: establish memory circuits.
TASK5: establish microprocessor interface circuits.
TASK6: construct microprocessor system circuits.
TASK7 familiarize assemble language.

DUTYF: design software

TASK1: operate DOS.
TASK2: operate WINDOWS.
TASK3: operate UNIX.
TASK4: familiarize a high-level language.
TASK5: familiarize a low-level language.

DUTYG: construct telecommunication circuits

TASK1: combine AM emmiter circuit.
TASK2: combine AM acceptor circuit.
TASK3: combine FM emmiter circuit.
TASK4: combine FM acceptor circuit.
TASK5: combine ultrasonic wave accepter circuit.
TASK6: combine ultrasonic acceptor circuit.
TASK7: combine ultrared ray emmiter circuit. TASK8 combine ultrared ray acceptor circuit.

DUTYH: apply computer-assisted drawing

TASK1: use basic drawing.
TASK2: use electronic drawing.
TASK3: operate drawing software.
TASK4: operate PC board software.

DUTYI: fabricate project	TASK1: investigate new product and technology. TASK2: analyze new product and technology. TASK construct prototype products. TASK4: operate instruments and equipments. TASK write technical reports. TASK6: declare new products.
DUTYJ: use applied software	TASK1: use document processing software. TASK2: use management software. TASK3: use statistic software. TASK4: use publishing software.
DUTYK: monitor production management	TASK1: maintain safe work. TASK2: maintain sanitary work. TASK3: control production sequences. TASK4: manage production quality.
DUTYL: conduct technical services	TASK1: use troubleshooting skill. TASK2: maintain product function. TASK3: analyze product market. TASK4: establish sale market.

III. Design and Implementation of Research

The present research is developed in accordance with the aforementioned tasks and contents, the design and implementation of research are described below:

1.Methodology

(1) Document Analysis

Based on the objectives of study, we have gathered the curricular standard and equipment standard of department of electronic engineering of two-year junior colleges promulgated by the Ministry of Education (MOE) in January 1983 and the subject catalogue & teaching materials outlines and related research reports of department of electronic engineering of two-year junior colleges promulgated by the MOE in June 1994 and performed document analysis and selected and studied related information as basis for the theory. Then, we have performed analysis, comparison, integration, categorization and transformation on the 12 duties, 73 tasks and their contents to determine the draft work of the technological subjects and their credits and credit-hours.

(2)Expert Committee

We have invited scholars of the professional subject planning committee of electronic engineering departments of junior colleges; experienced chairpersons and senior professional instructors of the faculty to form the assessment committee to determine the technological subjects and their credits and credit-hours of electronic engineering departments of junior colleges as basis for the questionnaire.

(3)Questionnaire Survey

The respondents of the survey are all the two-year junior colleges that have an electronic engineering department. We have sent 4 copies of questionnaire to each faculty: one of them was to be answered by the chairperson of faculty; the other three copies were answered randomly by instructors who have a lecturer or above status, in order to gather a wide variety of opinions toward the required and optional technological subjects, their credits and credit-hours from instructors of different levels to obtain information that consists of both quality and quantity.

2. Questionnaire Making

Document analysis has been used to transformed tasks and contents of job technological ability of electronic engineering graduates of junior colleges into technological subjects and their credits and credit-hours. Then the result was revised and modified in the expert committee to enhance the validity of the content, and 26 subjects and their credits and credit-hours have been drawn out as major contents of the questionnaire. Then, together with the information in the aforementioned three items, the elementary version of questionnaire was formed. Then two technological and vocational education scholars and three full-time instructors from each of the lectronic engineering faculty of National Taipei College of Technology, Yatung Junior College of echnology and Szehai Junior College of Technology were invited to trial the questionnaire and xpress their opinions toward the questionnaire. The final version of the questionnaire was formed ter further revision and modification to enhance the content validity.

Implementation of Survey

The respondents of the study were instructors of professional subjects in all two-year junior colleges in Taiwan that have electronic engineering departments. First, we have located 29 junior colleges from the technological and vocational schools index published by the Department of Technological and Vocational Education, MOE. In order to gather information from instructors of different levels, we divided the framework into two sections, the chairpersons and instructors of professional subjects: chairpersons were appointed respondents, while only three instructors chosen randomly from each electronic engineering faculty were respondents. To enhance the recollection rate of questionnaire, we invited the president of National Taipei College of Technology to write a letter to invite all junior colleges to answer the questionnaire. After several presses by phone, we finally collected questionnaire from 28 schools from 16 to 31 May 1995, and only one school did not send us their reply. The total copies of questionnaire collected is 106, at a recollection rate of 91.4%.

4. Data Processing

After processing the collected questionnaires, we performed data processing and analysis according to the several themes of the contents of questionnaire: (1) basic data: percentage has been used to interpret the background information, teaching experience and working experience in electronic occupation of respondents; and (2) subjects and their credits and credit-hours: X^2 has been used to compare the opinions of chairpersons and instructors toward each subject.

IV.Survey Result and Analysis

Here are the excerpts of the result and analysis of the present research:

1. Basic Information Analysis:

Tables 3-1-1 and 3-1-2 are statistics of the number and percentage of the background information of chairpersons; Tables 3-2-1 and 3-2-2 are statistics of the number and percentage of the background information of instructors. The results indicated that more than 80% of the respondents had a teaching experiences or at least two years; more than 80% of tne chairpersons and more than 70% of instructors had at least one year' working experience in electronic occupation.

Table3-1-1 chairpersons background

Teaching (year)	N	%
below 2	3	15
2-5	3	15
above 5	14	70
total	20	100

Table3-1-2 chairpersons background

Trade (year)	N	%
below 1	3	15
1-3	11	55
above 3	6	30
total	20	100

Table3-2-1 instructors background

Teaching (year)	N	%
below 2	11	12.8
2-5	33	38.8
above 5	42	48.8
total	86	100.0

Table3-2-2 instructors background

Trade (year)	N	%
below 1	20	27.4
1-3	31	42.5
above 3	22	30.1
total	73	100.0

2. Analysis of Subjects and their Credits and Credit-Hours:

Table 3-3-1 is the percentage of the total number of people opinion toward whether a subject should be required, optional or both and the x2 of the opinion of chairpersons and instructors opinion toward whether a subject should be required, optional or both. Figures with an asterisk represent they have reached the significant level of .05, and figures without an asterisk represent they are below the significant level, which means that the opinions of both chairpersons and instructors are the same.

Table 3-3-1 the percentage and x^2 of the total pepole opinions toward required or optional

Items	Subjects	Required N(%)	Optional N(%)	Both N(%)	x^2
E01	electronic circuit design	59	32	8	3.141
E02	electronic instrument	39	56	5	1.485
E03	sensor & conventer	36	57	7	11.783*
E04	circuit board design software	34	63	3	5.810
E05	logic design	86	10	4	2.027
E06	computer architeture	86	10	4	3.667

E07	pragrammable array logic circuit design	39	50	11	3.962
E08	single-chip & interface ciecuit	81	9	9	3.137
E09	PC interface circuit	75	20	5	4.384
E10	PC assembly	73	23	4	1.014
E11	computer programming	75	24	1	0.830
E12	c++ language	25	67	8	0.759
E13	WINDOWS pragramming	16	77	7	0.857
E14	data struture	74	23	3	3.935
E15	system programming	59	35	6	0.866
E16	independent study	82	13	5	2.649
E17	communication principles	47	46	7	3.933
E18	TV & lab	9	85	6	0.418
E19	industrial safty & hygiene	16	74	10	4.118
E20	production management	17	77	6	2.986
E21	quality control	6	82	11	7.534*
E22	market survey	3	89	8	1.012
E23	PC maintenance & practice	18	75	7	0.496
E24	pragrammable controller & lab	22	69	9	3.145
E25	multimedia making	4	86	10	7.634*
E26	technical English	26	62	12	6.017*

Table3-3-2 is the percentage of the total number of people opinion toward whether the credits of a subject should be increased, remained unchanged or reduced and the x2 of the opinion of chairpersons and instructors opinion toward whether credits of a subject should be increased, remained unchanged or reduced. Figures with an asterisk represent they have reached the significant level of .05, and figures without an asterisk represent they are below the sinificant level, which means that the opinions of both chairpersons and instructors are the same.

Table 3-3-2 the percentage and x^2 of the total people opinions toward credits

Items	Subjects	Credits	Hours	Increase N(%)	Unchange N(%)	Uncrease N(%)	x^2
E01	electronic circuit design	2	4	12	83	5	1.193
E02	electronic instrument	3	3	3	84	13	1.041
E03	sensor & conventer	3	3	1	92	6	0.918

E04	circuit board design software	2	4	4	88	8	6.655*
E05	logic design	3	3	4	95	1	0.464
E06	computer architeture	3	3	7	92	1	2.775
E07	pragrammable array logic circuit design	2	4	7	90	3	3.057
E08	single-chip & interface ciecuit	2	4	25	75	0	2.846
E09	PC interface circuit	3	3	12	87	1	0.829
E10	PC assembly	2	4	4	92	4	2.759
E11	computer programming	2	4	9	89	1	2.428
E12	c++ language	2	4	3	96	1	4.360
E13	WINDOWS pragramming	2	4	3	94	3	1.387
E14	data struture	3	3	1	98	1	0.566
E15	system programming	3	3	4	96	0	3.560
E16	independent study	4	8	2	88	9	1.143
E17	communication principles	3	3	5	91	4	0.311
E18	TV & lab	2	4	5	92	3	0.853
E19	industrial safty & hygiene	3	3	1	68	31	9.675*
E20	production management	3	3	0	75	25	4.813
E21	quality control	3	3	0	73	22	5.004
E22	market survey	3	3	0	67	33	5.070
E23	PC maintenance & practice	2	4	3	90	7	2.510
E24	pragrammable controller & lab	2	4	4	92	4	1.105
E25	multimedia making	2	4	1	92	7	1.811
E26	technical English	2	2	4	86	10	3.105

Table 3-3-3 is the percentage of the total number of people opinion toward whether the credit-hours of a subject should be increased, remained unchanged or reduced and the x2 of the opinion of chairpersons and instructors opinion toward whether credit-hours of a subject should be increased, remained unchanged or reduced. Figures with an asterisk represent they have reached the sinificant level of .05, and figures without an asterisk represent they are below the sinificant level, which means that the opinions of both chairpersons and instructors are the same.

Table 3-3-3 the percentage and x^2 of the total people opinions toward hours

Items	Subjects	Credits	Hours	Increase N(%)	Unchange N(%)	Uncreae N(%)	x^2
E01	electronic circuit design	2	4	10	85	5	1.441
E02	electronic instrument	3	3	3	86	11	0.878
E03	sensor & conventer	3	3	4	91	5	2.203
E04	circuit board design software	2	4	3	88	9	4.550*
E05	logic design	3	3	7	92	1	0.451
E06	computer architeture	3	3	9	90	1	4.441
E07	pragrammable array logic circuit design	2	4	5	89	5	0.393
E08	single-chip & interface clecuit	2	4	21	78	1	0.756
E09	PC interface circuit	3	3	12	85	3	0.625
E10	PC assembly	2	4	5	90	5	2.925
E11	computer programming	2	4	11	85	4	0.986
E12	c++ language	2	4	7	90	3	3.910
E13	WINDOWS pragramming	2	4	3	92	5	2.097
E14	data struture	3	3	4	95	1	3.000
E15	system programming	3	3	5	93	1	1.847
E16	independent study	4	8	4	84	12	0.525
E17	communication principles	3	3	10	87	3	0.683
E18	TV & lab	2	4	1	94	5	4.000
E19	industrial safty & hygiene	3	3	0	68	32	5.389
E20	production management	3	3	0	73	27	5.398
E21	quality control	3	3	0	71	29	6.290*
E22	market survey	3	3	0	69	31	7.292*
E23	PC maintenance & practice	2	4	0	91	9	2.272
E24	pragrammable controller & lab	2	4	3	94	3	1.468
E25	multimedia making	2	4	1	92	7	13.992*
E26	technical English	2	2	7	83	10	3.789

V. Conclusion and Recommendations

The present research performed an information analysis according to the objectives of research, and the discoveries and conclusion are stated below.

1. After the technological competency analysis, document analysis and expert committee, we confirmed that the electronic engineering major students of two-year junior colleges require 26 technological subjects and their credits and credit-hours as shown in Tables 3-3-2 and 3-3-3.

2. In opinions toward whether a subject should be required, optional or both, major differences in opinions of chairpersons and instructors are only found in the following subjects: sensors and converters (E03), quality control (E21), multimedia making (E25) and technical English (E26), and they have the same opinions for the other subjects. More than 70% of the respondents consider the following subjects should be required: logic design (E05), computer architecture (E06),single chip and interface circuit (E08), PC interface circuit (E09), PC Assembly lab (E10), computer programming (E11), data structure (E14), special project (E16); and the rest of the subjects can be optional.

3. In opinions toward whether credits of a subject should be increased, remained unchanged or reduced, major differences in opinions of chairpersons and instructors are only found in the following subjects: circuit board design software (E04) and industrial safety and hygiene (E19), and they have the same opinions for the other subjects. More than 70% of the respondents consider the present credits of subjects should remain unchanged [except industrial safety and hygiene (E19) and market survey (E22)].

4. In opinions toward whether credit-hours of a subject should be increased, remained unchanged or reduced, major differences in opinions of chairpersons and instructors are only found in the following subjects: quality control (E21), market survey (E22) and multimedia making (E25), and they have the same opinions for the other subjects. More than 70% of the respondents consider the present credits of subjects should remain unchanged [except industrial safety and hygiene (E19)].

5. More than 20% to 30% of total respondents think that the credits and credit-hours of the following subjects should be reduced: industrial safety and hygiene (3/3), production management (3/3), quality control (3/3) and market survey (3/3).

6. 20% to 30% of total respondents think that the credits and credit-hours of the following subject should be increased: single chip and interface circuit (2/4).

According to the aforementioned conclusion, we have drawn out the following recommendations as reference for the implementation of the new electronic engineering curricular:

1. The electronic technological competecy related training provided by instructors and manufacturers are obviously different, especially the in-the-field management ability, marketing ability and knowledge of safety and hygiene. Most instructors think that the credits and credit-hours of these subjects should be reduced, and some of them even think that these subjects should be omitted. We recommend that we should establish industrial and academic cooperation and exchange from different aspects to promote mutual understanding and shorten the gap of identification through demonstration, speech, visit, seminar, special project and in-the-field production cooperation.

2. The subjects confirmed in the present study are job-oriented, we recommend that we should develop a grade A, B and C technician evaluation system to facilitate the reforms. Such an evaluation system can evaluate the result of teaching on one hand and help outstanding students to get a job on the other.

3. For students who have good academic achievement and want to further their studies, in order to allow them to follow the future studies, we recommend to open advanced optional subjects such as engineering mathematics, communication system, electromagnetism, digital signal processing...etc for them.

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